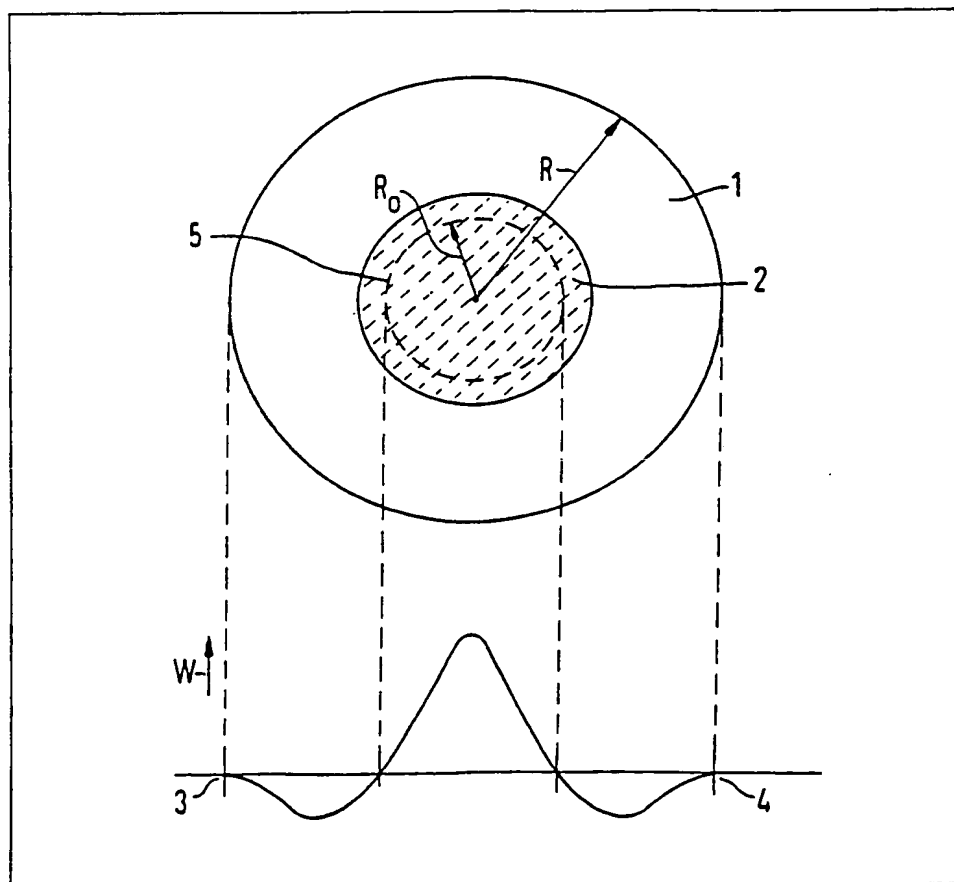


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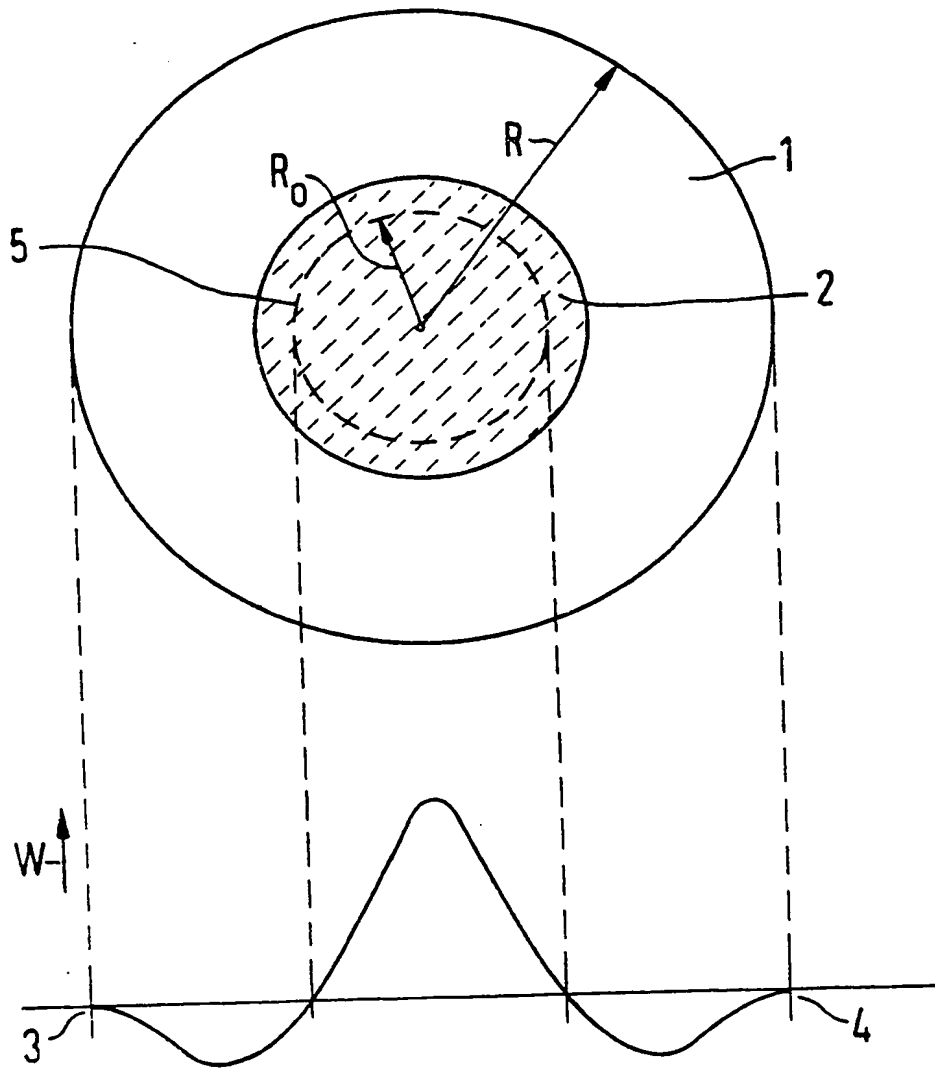
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(54) **Electro-acoustic transducer**

(57) An electro-acoustic transducer (e.g. for use as a microphone in tele-  
 phone systems) has a transducer plate  
 (1) clamped at its periphery and having  
 a piezoelectric layer (2). In order to  
 reduce the increase in sensitivity which  
 would otherwise be caused by the  
 fourth harmonic resonance of the plate,  
 the piezoelectric layer (2) is so dimen-  
 sioned that, in use, the circular node  
 which is characteristic of the fourth  
 harmonic lies within the piezoelectric  
 layer.



GB 2 025 733 A



## SPECIFICATION

## Electro-acoustic transducer

5 The invention relates to an electro-acoustic transducer plate which is clamped at its peripheral region by means of two supporting elements, is subjected to bending stress and is provided with a piezo-electric layer, and which, in the intended conversion frequency range in addition to the resonance peak (0/0) corresponding to the fundamental frequency of the transducer plate also forms higher order harmonics, especially the fourth harmonic component which has the vibration mode (0,1) and is characterised by a circular node.

10 A transducer of this type is known from German patent No. 1 961 217. In this transducer both fundamental vibrations and the higher order harmonics, especially the fourth order harmonic characterised by a circular node, are displaced into the intended conversion frequency range of the transducer, in order to obtain a conversion factor as high as possible. This can be achieved either through the transducer plate itself or, in the case of the transducer plates mentioned, through their clamping, especially their clamping in the peripheral region. Both the vibrational forms mentioned arise and are further damped by virtue of corresponding measures in the transducer, to the extent that an equalised approximately constant conversion factor extending to higher frequencies is obtained. Then the fundamental resonance is damped by known absorption-resonators, and the fourth order harmonic can be damped *inter alia* by special design of the supporting elements.

Further, this harmonic can be damped by damping materials, e.g. by a damping silk pasted into the transducer mounting.

40 According to the present invention there is provided an electro-acoustic transducer with a transducer plate which is clamped at its peripheral region by means of two supporting elements, is subjected to bending stress and is provided with a piezoelectric layer, and which, in the intended conversion frequency range, in addition to the resonance peak (0/0) corresponding to the fundamental frequency of the transducer plate also forms higher order harmonics, especially the fourth harmonic component which has the vibration mode (0,1) and is characterised by a circular node, wherein the piezoelectric layer is so dimensioned that the circular node of the fourth harmonic occurs within the piezoelectric layer.

A special design of the supporting elements and/or additional damping materials can thereby be rendered unnecessary. The further into the region provided with the piezoelectric layer the circular node is situated, the more can the excess be reduced.

Preferably the piezoelectric layer is circular-symmetric and is provided on each side with a respective radially symmetric electrode.

In this way the excess can be further reduced.

A square, hexagonal, pentagonal or octagonal form of the piezo layer has a favourable influence on the reduction of the sensitivity excess.

The fourth harmonic with a circular node corresponds for example with a square form of the piezo layer, to the fifth harmonic. The diameter of the circular node is then smaller than in the case of a radially symmetric piezo layer, so that the same effect according to the invention can be achieved with smaller and therefore cost favourable piezo layers.

As a further advantage of these layers the reduction in material cut away during the manufacture of the disc is worth mentioning.

In the following an exemplary embodiment of the invention will be explained with reference to the accompanying drawing. This drawing shows a transducer plate 1, which consists of aluminium and has a diameter 2R of 43 mm and 250  $\mu$ m thickness. The transducer plate is provided with a circular piezo layer 2 (diameter R, 150  $\mu$ m thickness) which is arranged radially symmetrically on this transducer plate. The electrodes assigned to this layer 2 are not shown, for reasons of clarity. Likewise not shown in the support of the transducer plate, which however is in the case shown here supported in a silicone ring or between a pair of silicone rings. As the graphical illustration now shows, the fourth harmonic mode has several zero crossings, viz. in the frame 3, 4 and at the node circle 5, which has a radius of R<sub>0</sub>. It can be seen from this illustration that the increase of the sensitivity (amplitude W) integrated over the vibrating area can be the more reduced the more is the node diameter displaced into the region of the piezo layer 2.

There is thus provided means whereby the excess in sensitivity caused by the fourth harmonic can be reduced by structurally simple means.

The invention is useful particularly, but not exclusively, in relation to microphones for use in telephone systems.

## CLAIMS

1. An electro-acoustic transducer with a transducer plate which is clamped at its peripheral region by means of two supporting elements, is subjected to bending stress and is provided with a piezoelectric layer, and which, in the intended conversion frequency range in addition to the resonance peak (0/0) corresponding to the fundamental frequency of the transducer plate also forms higher order harmonics, especially the fourth harmonic component which has the vibration mode (0,1) and is characterised by a circular node, wherein the piezoelectric layer is so dimensioned that the circular node of the fourth harmonic occurs within the piezoelectric layer.

2. An electro-acoustic transducer according to claim 1, in which the piezoelectric layer is formed circularly symmetrically and is provided on each side with a radially symmetric electrode.

3. An electro-acoustic transducer according to claim 2, in which the piezoelectric layer has a square, pentagonal or octagonal form.

4. An electro-acoustic transducer substantially as herein described with reference to the accompanying drawing.

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